#21 / Appeal Brief (3)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellants: Hall et al.	:	Group Art Unit: 2613
Serial No.: 09/046,121	:	Examiner: Wong, Allen C.
Filed: March 20, 1998	:	Appeal No.:

For: ADAPTIVELY ENCODING A PICTURE OF CONTRASTED COMPLEXITY HAVING NORMAL VIDEO AND NOISY VIDEO PORTIONS

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Date of Signature: January 16, 2003

Board of Patent Appeals and Interferences
Assistant Commissioner for Patents
Washington, D.C. 20231

Supplemental Brief of Appellants

Dear Sir:

This is a Supplemental Appeal Brief supporting Appellants' Request for Reinstatement of the previously filed Appeal of a portion of the claims being considered in the above-identified application. The Request for Reinstatement of Appeal, and this Supplemental Appeal Brief are responsive to the final rejection dated November 27, 2002 rejecting claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38, a portion of the claims

being considered in the above-identified application. Appellants request that the prior filed fees paid for the original Notice of Appeal and Appeal Brief be applied to the present Request for Reinstatement of the Appeal and the filing of this Supplemental Appeal Brief.

Real Party In Interest

This application is assigned to **International Business Machines Corporation** by virtue of an assignment executed on March 19, 1998 by the co-inventors, and recorded with the United States Patent and Trademark Office at reel 9053, frame 0202, on March 20, 1998. Therefore, the real party in interest is **International Business Machines Corporation**.

Related Appeals and Interferences

To the knowledge of the appellants, appellants' undersigned legal representative, and the assignee, there are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

Status of Claims

This patent application was filed on March 20, 1998 with the United States Patent and Trademark Office. As filed, the application contained thirty-eight (38) claims, of which six (6) were independent claims (i.e., claims 1, 17, 24, 31, 37 and 38).

In an initial Office Action dated June 30, 2000, claims 1-38 were subject to restriction under 35 U.S.C. §121 between Group I (claims 1-16, 24-30 and 37) and Group II (claims 17-23, 31-36 and 38); claims 1-3, 7, 9, 24, 25, 28 and 37 of provisionally

elected Group I were rejected under 35 U.S.C. §102(e) as being anticipated by Uz (U.S. Patent No. 5,771,316); claims 4, 5, 11-13, 15, 16 and 26 were rejected under §103(a) as being unpatentable over Uz (U.S. Patent No. 5,682,204; hereinafter, references to Uz indicate this '204 patent, rather than the above-mentioned '316 patent); and claims 6, 8, 10, 14, 27, 29 and 30 were objected to as being dependent upon a rejected base claim, but were indicated as being allowable if rewritten in independent form. In appellants' response mailed September 28, 2000, claim 11 was canceled; claims 1, 12, 24 and 37 were amended; claims 1-16, 24-30 and 37 were elected to conform to the restriction requirement; and the restriction requirement was traversed.

In a second Office Action dated December 20, 2000, the restriction requirement was withdrawn; claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Uz in view of Flannaghan (U.S. Patent No. 4,703,358); and claims 6, 8, 10, 14, 19, 27, 29 and 30 were objected to as being dependent upon a rejected base claim, but were indicated as being allowable if rewritten in independent form. In appellants' response mailed March 20, 2001, claims 1, 6, 8, 10, 14-17, 19, 20, 24, 27, 29, 31, 33, 37 and 38 were amended.

In a third and final Office Action dated May 25, 2001, claims 6, 8, 10, 14, 19, 27, 29 and 30 were allowed; and claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Uz in view of Flannaghan (U.S. Patent No. 4,703,358). Appellants filed a Continued Prosecution Application on August 24, 2001, along with a preliminary amendment that amended claims 1, 6, 8, 10, 14, 15, 16, 17, 19, 24, 27, 29, 31, 33, 37 and 38.

In a next Office Action dated November 7, 2001, claims 6, 8, 10, 14, 19, 27, 29 and 30 were allowed; and claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rejected as being unpatentable over Uz and Flannaghan in view of Park (U.S. Patent No.

5,825,930). Appellants' response, mailed February 7, 2002, amended claims 1, 2, 12, 16, 17, 23-25, 31, and 36-38.

In a final Office Action dated March 25, 2002, claims 6, 8, 10, 14, 19, 27, 29 and 30 were allowed; claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rejected as being unpatentable over Uz in view of Flannaghan; and the rejection dated November 7, 2001 was corrected to remove the Park reference, allowing the rejection to stand based on the combination of Uz and Flannaghan. In appellants' response mailed May 21, 2002, no claims were amended.

Pursuant to an Advisory Action dated June 24, 2002, appellants' remarks, filed June 3, 2002 at the U.S. Patent and Trademark Office in response to the final Office Action were not deemed to place the application in condition for allowance.

A Notice of Appeal to the Board of Patent Appeals and Interferences was filed on July 9, 2002, accompanied by a one-month extension of time request.

Appellants' Appeal Brief was mailed September 9, 2002 to the Board of Patent Appeals and Interferences, accompanied by the requisite fee set forth in 37 C.F.R. §1.17(c). Responsive thereto, a further final Office Action was issued November 27, 2002. Prosecution was reopened and a new ground of rejection set forth. Specifically, claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rejected as being unpatentable over Uz (U.S. Patent 5,682,204) in view of Resnikoff et al. (U.S. Patent No. 5,148,498; hereinafter referred to as Resnikoff).

The status of the pending claims is therefore as follows:

Claims allowed - 6, 8, 10, 14, 19, 27, 29 & 30

Claims objected to - none

Claims rejected - 1-5, 7, 9, 12, 13, 15-18,
20-26, 28 & 31-38

Claims canceled - 11

Status of Amendments

Appellants' remarks proferred in the Response to the final Office Action dated March 25, 2002 were entered upon filing of the Notice of Appeal and this Appeal Brief. However, no claim amendment was effectuated by the Response. The claims as set out in the Appendix include all prior entered amendments.

Summary of the Invention

The present invention is a particular technique for encoding a video frame of a sequence of video frames (e.g, claim 17), wherein the frame may include a noisy video (i.e., random noise) portion 260 (Fig. 5) and a normal video portion 270 (Fig. 5). The technique includes for each macroblock of the frame: using intraframe statistics to determine, without reference to another frame, whether a frame includes a random noise portion and a normal video portion (see Figs. 6 & 7 and the discussion at pages 17-20 of the specification); and for a frame that does include a random noise portion and a normal video portion, evaluating each macroblock in the frame 650 (Fig. 8) and adjusting encoding of at least some macroblocks within the random noise portion of the frame 710 (Fig. 8). This encoding adjustment reduces bits used in encoding the at least some macroblocks within the portion of the frame by biasing the macroblock coding towards predictive coding (see Fig. 8 and the discussion at pages 20-22 of the specification).

In a further aspect, e.g., claim 1, the present invention includes a technique for encoding a single video frame having a random noise portion 260 and a normal video

portion 270 (Fig. 5). The technique includes for each macroblock of the frame: determining a macroblock activity level 660 (Fig. 8); determining whether the macroblock activity level exceeds a predefined threshold 670, wherein the macroblock activity level exceeding the predefined threshold indicates that the macroblock is associated with the random noise portion 260 of the video frame; and adjusting encoding of the macroblock when the macroblock activity level exceeds the threshold, using predictive code biasing, to thereby provide a bit conservation advantage as described above.

In still further aspects, the present invention includes techniques for: determining a macroblock's activity level by determining an activity level for each block within the macroblock (e.g., claim 3; see specification, page 16 line 28 - page 17, line 15); adjusting macroblock coding to bias towards predictive coding when the macroblock activity level exceeds a predefined threshold value (e.g., claim 7; see specification, page 21, lines 20-28); and calculating a frame complexity value based on unencoded input picture pixels (e.g., claims 12 & 13; see Fig. 7 and specification, page 19, line 14 - page 20, line 13).

Issues

Whether claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38 were rendered obvious under 35 U.S.C. §103(a) by Uz in view of Resnikoff.

Grouping of Claims

As to the rejections applied against claims 1-5, 7, 9, 12, 13, 15-18, 20-26, 28 and 31-38, it is appellants' intention that the rejected claims do not stand or fall together. For example, appellants respectfully submit that the following claim groups have separate basis for patentability:

I: Claims 17, 23, 31 & 38;

II: Claim 1, 2, 9, 21, 24, 25 & 37;

III: Claim 3-5 & 26;

IV: Claims 7 & 28; and

V: Claim 12, 13, 15, 16, 18, 20, 22 & 32-36.

Argument

Group I: Claims 17, 23, 31 & 38

As noted, claims 17, 23, 31 & 38 stand rejected as obvious over Uz in view of Resnikoff. Reversal of this rejection is respectfully requested.

This invention is directed to a technique for encoding a frame in a sequence of frames, wherein each frame has more than one macroblock. After using intraframe statistics (i.e., without reference to another frame) to determine the existence of a random noise portion and a normal video portion within a frame, macroblocks of the frame are evaluated and encoding of at least some of the macroblocks within the random noise portion of the frame are adjusted. The adjustment results in the reduction of bits used in encoding a macroblock associated with the random noise portion. By this reduction of bits used in the random noise portion of the frame, the present invention preserves more bits for the normal video portion. Since the applied art does not teach or suggest the above-outlined concepts, appellants respectfully request reversal of the stated obviousness rejection.

Uz describes a rate control algorithm for an MPEG-2 compliant encoder. See abstract. The rate control algorithm has embodiments useful for constant bitrate and

variable bit rate encoding. In particular, the Uz invention relates to a quantization biased, activity based, inter/intra decision.

A careful reading of Uz fails to uncover any teaching, suggestion or implication of the problem addressed by the present invention. Uz addresses encoding a sequence of frames for constant bit rate or for variable bit rate. Further, Uz notes that the MPEG-2 specification allows a frame to be encoded as a frame picture or the two fields thereof to be encoded as two field pictures. Frame encoding or field encoding can be adaptively selected on a frame-by-frame basis. Frame encoding is typically preferred when the video scene contains significant detail with limited motion. Field encoding, in which the second field can be predicted from the first, is noted to work better when there is fast movement. See column 3, lines 20-29.

While Uz is directed to a rate control algorithm for encoding a sequence of frames for either constant bit rate or variable bit rate, a careful reading thereof fails to uncover any teaching, suggestion or implication of the problem addressed by the present invention. Again, the current invention addresses encoding a frame <u>containing both a random noise portion and a normal video portion</u>, meaning that the frame necessarily contains areas of significantly contrasted complexity.

Further, appellants note that Uz suggests the use of "frame encoding" when "the video scene contains significant detail with limited motion". Column 3, lines 25-27. According to Uz, in encoding a frame containing a noisy portion (i.e., a portion with fast movement) field encoding is preferred. For field prediction data, one or more previous fields or previous and subsequent fields is needed. Column 3, lines 30-33. (Appellants note that the Examiner in the remarks contained with the final Office Action of March 25, 2002 interchanged what frame encoding and intra-frame encoding mean. Frame encoding is discussed in Uz at column 3, lines 25-28, which is distinct from intra-frame encoding.)

More particularly, frame coding refers to coding all the pixel lines within a single frame in a progressive format. Thus, the horizontal pixel lines coded are 1, 2, 3, 4.... Intra-frame coding refers to not using temporal redundancy to lessen the amount of data needed to code a frame. That is, all information used to code a frame is contained within the frame. No motion estimation or compensation is utilized. Intra-coding is used for certain macroblocks depending on coded picture type, and is present in either field or frame coded pictures.

In accordance with the present invention, a frame having both a random noise portion and a normal video portion does not affect the bit budget determined for that picture by other means, or whether the picture is to be frame or field encoded. What it does affect are some of the decisions used to determine how to encode a macroblock within the random noise portion of the picture. These decisions are biased in certain directions based on the predetermination that both a random noise portion and a normal video portion are present within the picture.

The current invention adjusts the encoding of a single frame by reducing bits used in encoding macroblocks within the random noise portion of the frame. In this way, the current invention <u>preserves more bits for the less noisy area (i.e., normal video portion) of an image at the expense of the highly complex image area</u> (i.e., random noise portion) of the frame. Uz makes no similar adjustment (nor does Resnikoff).

This adjustment is particularly recited in each of the aforementioned independent claims. Specifically, the adjusting is accomplished by biased encoding of the macroblocks in the random noise area of the frame. The encoding is biased towards predictive coding, and thus, away from intra-coding. This saves bits which would

otherwise be used to encode the macroblock as an intra-coded macroblock. Again, Uz makes no similar adjustment to that recited by appellant.

In appellants' invention, bits are conserved by adjusting encoding of a macroblock that falls within the random noise portion of the frame and then using those conserved bits for macroblocks that fall within the normal video portion. This is because a viewer's attention will naturally be directed to the normal video portion of the frame, since the remaining portion of the frame is random noise. This conserving of bits for the normal video portion is believed unique to the present invention. A careful reading of the applied art fails to uncover any suggestion or implication that bits should be conserved from, for example, a highly complex image area for use in a "normal video" portion which contains less complexity. Appellants' invention is believed counterintuitive in this aspect.

As recognized in the Office Actions cited above, a careful reading of Uz does not disclose any mention of appellants' concept of determining whether a frame includes a noisy portion, let alone both a random noise portion and a normal video portion. For a teaching of this concept, the new final Office Action references Resnikoff (in particular, Figs. 2 & 3, and column 10, lines 3-20 of Resnikoff). This characterization of Resnikoff is respectfully traversed.

Resnikoff describes an image coding apparatus and method for processing a single image utilizing FIR filters which generate three or more sets of coefficients from linear transform arrays generated from an image being coded. Each set of coefficients represents the transform data in frequency domain. As shown in Fig. 3, and described in column 10, lines 38-56, an image 72 is input to an <u>image transformer 40</u> (Fig. 2) which generates four sets of coefficients 74-77. Each set of coefficients has one-fourth the number of elements of image 72. These coefficients are in the <u>frequency domain</u>, with the LL array comprising lower frequency information than the other arrays. As is well

known, in the frequency domain, the lower frequency information is more important to human viewers. Hence, Resnikoff presents an image compression scheme in which the coefficients of the LL array are quantized with a greater number of bits than the coefficients of the other arrays 75-77. In one simple version of the technique, only coefficients of the LL array are quantized. That is, zero bits are allocated for each of the coefficients of the LH, HL, and HH arrays. (See column 10, lines 3-20 of Resnikoff).

There are significant differences between Appellants' claimed invention and the teachings of Resnikoff. For example, Resnikoff describes a lossy compression scheme which would be analogous to, or in place of a discrete cosine transform 21 (see Fig. 1) in Appellants' invention. Both Appellants' and Uz do employ at a certain point in processing a transformation of raw pixel data from the spatial domain to the frequency domain. Resnikoff describes one lossy compression approach which employs linear transformation and filtering of the frequency domain coefficients to rid the transform data of high frequency coefficients. The attempts in the final Office Action to analogize this frequency domain filtering to applicants' claimed invention are respectfully traversed.

The lossy compression technique of Resnikoff does not teach, suggest or imply Appellants' concept of using intraframe statistics to initially determine without reference to another frame whether a frame to be encoded includes a random noise portion and a normal video portion. The attempts to characterize the frequency coefficients in Resnikoff as a normal video portion and noisy portion of a frame are believed to be misplaced. As is well known to one skilled in the art, transformation of a pixel from the spatial domain to the frequency domain results in <u>both</u> low frequency coefficients and high frequency coefficients. Thus, pixels from a random noise portion of a frame would result in both low frequency and high frequency coefficients once undergoing linear transformation as taught by Resnikoff, as would pixels from a normal video portion of a frame. Based upon this, appellants respectfully submit that the Examiner's rationale

contained in the final Office Action is merely an attempt at impermissible hindsight reconstruction of Appellants' recited invention, gleaned from Appellants' own disclosure.

Appellants' recite a technique for dynamically adapting encoding of a frame having a random noise portion and a normal video portion. Advantageously, processing in accordance with the present invention prevents noisy macroblocks or blocks with random details from consuming all or most of the picture bits, which in turn prevents overproduction of bits before the encoder reaches the bottom of a given picture. The present invention essentially directs encode bits from the random noise macroblocks of a frame to the simpler, normal macroblocks of the frame, thereby using fewer bits in the highly active and fine detail area. This is recited in the independent claims presented herewith as adapting the encoding of a macroblock within a random noise portion of a frame so as to bias the encoding thereof towards predictive coding (and thus away from intra-coding).

Appellants note that Resnikoff (as with Uz) does not address or discuss the same problem as that to which the present invention is directed. Resnikoff describes a lossy compression scheme which removes high frequency coefficients of transformed pixel data. Since both noisy video portions of a frame and normal video portions of a frame would have low frequency coefficients and high frequency coefficients when transformed as taught by Resnikoff, Appellants respectfully submit that the teachings of Resnikoff do not correlate to their claimed invention. A careful reading of Resnikoff fails to uncover any discussion directed to a dynamic encode approach which prevents random noise macroblocks or blocks with random details within a frame from consuming all or most of the picture bits for that frame. For this reason, Appellants respectfully submit that one of ordinary skill in the art would not have combined the teachings of Resnikoff and Uz to arrive at a dynamic encode approach as recited in the independent claims of the present invention.

To summarize, appellants respectfully submit that their invention as recited in the independent claims presented herewith would not have been obvious to one of ordinary skill in the art based on the teachings of Uz and Resnikoff. Neither patent addresses or discusses the same problem as that to which the present invention is directed. Although appellants recognize that Uz describes an adaptive encoding approach, the problem addressed therein, how the adaptation occurs, as well as the specific adaptation are different from that of the adaptive encoding approach of the present invention. The current invention addresses encoding an image containing both a random noise portion and a normal video portion in the received image.

Based on the foregoing, appellants respectfully request reversal of the obviousness rejection of claims 17, 23, 31 and 38.

<u>Group II: Claims 1, 2, 9, 21, 24, 25 & 37</u>

Claims 1, 2, 9, 21, 24, 25 & 37 were also rejected by the Examiner as obvious over Uz in view of Resnikoff. Appellants respectfully request reversal of this rejection.

As recited in independent claim 1, for example, the current invention teaches (in part) encoding a frame containing both a random noise portion and a normal video portion and adjusting the encoding of the frame by conserving bits used in encoding macroblocks within the random noise portion. In this way, bits are saved for the normal video section at the expense of the random noise section, and a more constant picture quality is provided. As discussed above, Uz does not address identifying such frames and makes no similar encoding adjustment (nor does Resnikoff).

The independent claims of Group II also specify determining a macroblock activity level and adjusting the macroblock's encoding when its activity level exceeds a predefined threshold indicative of the macroblock being associated with a random noise portion of a frame. Again, this adjusting is performed by biasing the encoding towards predictive coding (i.e., away from intra-coding) and saves bits that would otherwise be used to encode the random noise portion of the frame. Uz makes no similar comparison of a macroblock activity level to a predefined threshold level (nor does Resnikoff).

Appellants believe the dependent claims in Group II are patentable for the same reasons as their respective independent claims, as well as for their own additional features. For example, in claim 9 of the present invention, appellants recite that the adjusting encoding includes determining an adjusted quantization level for use in encoding the macroblock. This adjusted quantization level is determined to conserve bits used in encoding the macroblock when the macroblock activity level exceeds the predefined threshold. In comparison, Uz discloses a scheme to adjust the quantization step size (column 12, lines 50-53) based on the bits used. The present invention refers to this calculation as CAL QL. In claim 9, the CAL QL is adjusted further in order to conserve bits because the macroblock has been found to be a noisy macroblock in a noisy portion of the frame. The adjusted quantization step size is referred to in the present application as ADJ QL. A careful reading of Uz reveals no teaching, suggestion or implication of a similar additional adjustment to its CAL QL calculation. Resnikoff also is silent as to an adjusted quantization calculation.

<u>Group III: Claims 3-5 & 26</u>

Claims 3-5 & 26 were also rejected in the final Office Action as obvious over Uz in view of Resnikoff. Reversal of this rejection is respectfully requested.

In dependent claims 3-5 and 26, appellants further recite a technique for determining a macroblock activity level wherein the macroblock comprises multiple blocks. The technique includes determining an activity level for each block of the macroblock, and ordering activity levels of the blocks and comparing the minimum activity level with the next to minimum activity level to derive an activity level for the macroblock.

In rejecting claim 26, the final Office Action states: "Uz fails to disclose the comparison of a minimum activity level of said order with a next to minimum activity level of said order to derive said activity level for said macroblock as disclosed by the applicant. Therefore, it would have been obvious to one of ordinary skill in the art to compare the minimum activity level of said order with a next to minimum activity level of said order to derive said activity level for said macroblock for encoding accuracy and efficiency. Appellants respectfully submit that a prima facie case of obviousness has <u>not</u> been stated against claim 26 (nor against claims 3-5) based upon this language.

Specifically, Uz computes its values by using the minimum values from the blocks within the macroblock <u>as well as those surrounding the macroblock</u>. Column 9, lines 12-21. Therefore, Uz always uses the minimum value calculated from blocks within and surrounding the macroblock as the value for the macroblock. In contrast, the current invention prioritizes the block values of those blocks <u>contained</u> <u>within the macroblock</u> from minimum to maximum. The invention then derives the macroblock activity level by comparing the minimum and next to minimum values. To the extent relevant to the current invention, Uz teaches away from both the use of information exclusively within the macroblock, as well as the use of a value other than the minimum as an activity level for the macroblock.

Obtaining the minimum value as taught by Uz does not require the ordering of values as recited by appellants. Appellants respectfully submit that the ordering of all block values is not disclosed, taught or suggested by Uz's use of the minimum value in calculating macroblock values.

The Examiner stated in the prior final Office Action: "Evidently, there is no fundamental difference between Uz's activity level calculation and appellants' activity level calculation because both pertain to activity level in macroblocks." This conclusion is believed in error. The fundamental difference between the two activity level calculations is clear from the discussion above. Simply because two approaches relate to achieving an activity level measurement does <u>not</u> mean that one approach teaches or suggests the other.

For the above reasons, appellants respectfully request reversal of the obviousness rejections to claims 3-5 & 26.

<u>Group IV: Claims 7 & 28</u>

The Examiner also rejected claims 7 & 28 as obvious over Uz in view of Resnikoff. Reversal of this rejection is respectfully requested.

Dependent claims 7 and 28 are believed patentable for the same reasons discussed above relative to Group II claims. Appellants further support patentability of these claims by noting that the present invention expressly recites a macroblock within a random noise portion is biased towards being predictive coded when the macroblock exceeds a predefined threshold. A careful reading of Uz (particularly the motion estimation discussion in column 11, lines 20-26) and Resnikoff fails to uncover any teaching, suggestion or implication of such a concept.

Group V: Claims 12, 13, 15, 16, 18, 20, 22 & 32-36

In dependent claims 12, 13, 15, 16, 18, 20, 22 & 32-36, appellants recite the determination of the existence of a random noise portion within a frame, and the setting of a flag to indicate that random noise exists. The determination of whether a random noise portion exists within a frame includes calculating a frame complexity value and comparing the frame complexity value to a predefined complexity threshold. In certain claims, the frame complexity value is defined as an accumulated absolute difference value (PIX-DIFF) derived from adjacent pixels of the plurality of pixels in the frame.

In comparison, the complexity measure in Uz is very different from that recited by appellants. Uz's complexity measurement is calculated after encoding the data (column 12, lines 60-66). In contrast, appellants' claims employ the input picture pixels and calculate complexity therefrom before encoding of the frame.

Thus, appellants note that Uz fails to discuss or suggest appellants' claimed feature of a pre-encode complexity measurement. Further, appellants respectfully submit that Resnikoff does not describe or suggest any of the above noted deficiencies of Uz when applied against these claims.

For all of the above reasons, reversal of the obviousness rejection to claims 12, 13, 15, 16, 18, 20, 22 & 32-36 is respectfully requested.

Conclusion

Appellants herein request reversal of the rejection set forth in the final Office Action. Appellants respectfully submit that their claimed invention was not obvious to

one of ordinary skill in the art based upon Uz in combination with Resnikoff. In support of their position regarding the claims, appellants note that no applied patent either addresses or solves the problem addressed by the present invention. For example, appellants describe a particular encoding technique for a video frame containing both a normal video portion and a random noise portion. Furthermore, appellants' invention includes conserving encoding bits that conventionally would be devoted to noisy portions and saving those bits for the normal video portion. In addition, many of appellants' dependent claims provide further characterizations, which are clearly absent from the applied art.

For all of the above reasons, appellants allege error in rejecting the subject claims as obvious based on the applied art. Accordingly, reversal of the rejection is respectfully requested.

Respectfully submitted,

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Dated: January 16, 2003

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Appendix

1. A method for encoding a frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said random noise portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said noisy portion of said frame towards predictive coding and thereby save bits otherwise used to encode said random noise portion of said frame and provide a more constant picture quality due to encoding of the frame.

2. The method of claim 1, wherein said method comprises using said saved bits from said random noise portion of said frame to encode macroblocks associated with said normal portion of said frame.

3. The method of claim 1, wherein each macroblock of said plurality of macroblocks comprises multiple blocks, and wherein said determining (i) comprises determining an activity level for each block of said multiple blocks of said macroblock, and deriving therefrom an activity level for said macroblock.

4. The method of claim 3, wherein said deriving comprises ordering activity levels of said multiple blocks of said macroblock and comparing a minimum activity level of said order with a next to minimum activity level of said order to derive said activity level for said macroblock.

5. The method of claim 4, wherein said comparing further comprises comparing said minimum activity level of said order with an average activity level of said multiple blocks of said macroblock to derive said activity level for said macroblock.

6. A method for encoding a frame having a plurality of macroblocks, said method comprising:

determining whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein each macroblock of said plurality of macroblocks comprises multiple blocks, and wherein said determining (i) comprises determining an activity level for each block of said multiple blocks of said macroblock, and deriving therefrom an activity level for said macroblock;

wherein said deriving comprises ordering activity levels of said multiple blocks of said macroblock and comparing a minimum activity level of said order with a next to minimum activity level of said order to derive said activity level for said macroblock;

wherein said comparing further comprises comparing said minimum activity level of said order with an average activity level of said multiple blocks of said macroblock to derive said activity level for said macroblock; and

wherein said comparing comprises determining whether said minimum activity level is less than one-half said next to minimum activity level and whether said minimum activity level is less than one-half said average activity level of said multiple blocks, and when both are so, defining said activity level of said macroblock as said next to minimum activity level of said order, otherwise defining said activity level of said macroblock as said minimum activity level of said order.

7. The method of claim 1, wherein said adjusting encoding (iii) comprises performing motion estimation on said macroblock and selectively adjusting macroblock coding type for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined threshold, said selectively adjusting being with reference to a predictive error value resulting from said performing motion estimation on said macroblock.

8. A method for encoding a frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein said adjusting encoding (iii) comprises performing motion estimation on said macroblock and selectively adjusting macroblock coding type

for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined threshold, said selectively adjusting being with reference to a predictive error value resulting from said performing motion estimation on said macroblock; and

wherein said selectively adjusting comprises determining when said predictive error is greater than a second predefined threshold and said predictive error is greater than one-half said macroblock activity level, and when both are so, adjusting a macroblock coding type parameter to bias said macroblock towards being coded predictive.

9. The method of claim 1, wherein said adjusting encoding (iii) comprises determining an adjusted quantization level for use in encoding said macroblock, said adjusted quantization level being determined to conserve bits used in encoding said macroblock when said macroblock activity level exceeds said predefined threshold.

10. A method for encoding a frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding

said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein said adjusting encoding (iii) comprises determining an adjusted quantization level for use in encoding said macroblock, said adjusted quantization level being determined to conserve bits used in encoding said macroblock when said macroblock activity level exceeds said predefined threshold; and

wherein said determining of said adjusted quantization level comprises calculating a quantization level (CAL QL) for said macroblock and defining said adjusted quantization level (ADJ QL) as:

ADJ QL=MIN((1 + 0.25 (TH2 - BR + 1))□CAL QL; MAX ALLOWED BY STANDARD)

Where: BR is the target bitrate;

TH2 is a second predefined value; and

MAX QL ALLOWED BY STANDARD is a maximum quantization level allowed by MPEG standard.

12. The method of claim 1, wherein said determining whether said frame comprises said random noise portion includes calculating a frame complexity value and comparing said frame complexity value to a predefined complexity threshold.

13. The method of claim 12, wherein said frame comprises a plurality of pixels, and wherein each pixel of said frame comprises a multi-bit value, and wherein said frame complexity value comprises an accumulated absolute difference value (PIX-DIFF) derived from adjacent pixels of said plurality of pixels of said frame.

14. A method for encoding a frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) determining a macroblock activity level;

(ii) determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein said determining whether said frame comprises said noisy portion includes calculating a frame complexity value and comparing said frame complexity value to a predefined complexity threshold;

wherein said frame comprises a plurality of pixels, and wherein each pixel of said frame comprises a multi-bit value, and wherein said frame complexity value comprises an accumulated absolute difference value (PIX-DIFF) derived from adjacent pixels of said plurality of pixels of said frame; and

wherein said PIX-DIFF is defined as:

$$\sum_{y=1,3,5\ldots}^{Max} \left| L_y - L_{y+1} \right|$$

Where: L represents luminance value of a pixel, and y represents pixel position within the frame.

15. The method of claim 13, further comprising setting a noisy picture flag to "0" when said frame complexity value is less than said predefined complexity threshold, wherein said flag set to "0" designates said frame as a non-noisy or normal frame.

16. The method of claim 13, wherein said determining whether said frame comprises said random noise portion further includes comparing a target bitrate for said frame to a predefined bitrate threshold and when said target bitrate for said frame exceeds said predefined bitrate threshold, said method further comprises setting a noisy picture flag equal to "0", wherein said flag set to "0" designates said frame as a non-noisy or normal frame, and if said target bitrate is less than said predefined bitrate threshold, then setting said noisy picture flag to "1", wherein said "1" noisy picture flag setting indicates said frame includes said random noise portion.

17. A method for encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said method comprising:

using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion; and

when said frame includes said random noise portion and said normal video portion, evaluating each macroblock of said plurality of macroblocks in said frame and adjusting encoding of at least some macroblocks thereof within said random noise portion of said frame, said adjusting comprising reducing bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.

18. The method of claim 17, wherein each frame of the sequence of frames comprises a plurality of pixels, each pixel of each frame comprising a multi-bit value, and wherein said determining whether said frame includes said random noise portion includes calculating a frame complexity value and comparing said frame complexity value to a predefined complexity threshold, said calculating of said frame complexity value including deriving an accumulated absolute difference (PIX-DIFF) from adjacent pixels of said plurality of pixels of said frame.

19. A method for encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said method comprising:

determining whether said frame includes a random noise portion; and

when said frame includes said random noise portion, evaluating each macroblock of said plurality of macroblocks in said frame and adjusting encoding of at least some macroblocks thereof within said random noise portion of said

frame, said adjusting comprising reducing bits used in encoding said at least some macroblocks within said random noise portion;

wherein each frame of the sequence of frames comprises a plurality of pixels, each pixel of each frame comprising a multi-bit value, and wherein said determining whether said claim includes said random noise portion includes calculating a frame complexity value and comparing said frame complexity value to a predefined complexity threshold, said calculating of said frame complexity value including deriving an accumulated absolute difference (PIX-DIFF) from adjacent pixels of said plurality of pixels of said frame; and

wherein said deriving of said PIX-DIFF comprises forming a string of pixels by concatenating said plurality of pixels of said frame and defining PIX-DIFF as:

$$\sum_{y=1,3,5\ldots}^{Max} \left| L_y - L_{y+1} \right|$$

Where: L represents luminance value of a pixel, and y represents pixel position within the string of pixels.

20. The method of claim 18, wherein when said frame complexity value is less than said predefined complexity threshold, said method further comprises setting a noisy picture flag to "0" and performing normal encoding on said frame, wherein said flag set to "0" designates said frame as a non-noisy or normal frame, and wherein when said frame complexity value is greater than said predefined complexity threshold, said method further comprises determining whether a target bitrate of said frame is less than a predefined bitrate threshold, wherein when said target bitrate of said frame exceeds said predefined bitrate threshold, said method comprises setting said noisy picture flag to "0",

and when said target bitrate of said frame is less than said predefined bitrate threshold, said method comprises setting said noisy picture flag to "1", wherein said "1" noisy picture flag setting indicates that said frame includes said random noise portion.

21. The method of claim 17, wherein said evaluating comprises for each macroblock determining a macroblock activity level and determining when said macroblock activity level exceeds a predefined activity threshold, wherein said macroblock activity level exceeding said predefined activity threshold indicates that said macroblock is within said random noise portion of said frame.

22. The method of claim 21, wherein said adjusting encoding comprises performing motion estimation on said macroblock and selectively adjusting macroblock coding type for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined activity threshold, said selectively adjusting being with reference to a predictive error value resulting from said performing motion estimation on said macroblock, and further comprising determining an adjusted quantization level for said macroblock for use in encoding said macroblock, said adjusted quantization level being determined to reduce bits used in encoding said macroblock.

23. The method of claim 17, wherein said reducing bits comprises conserving bits used in encoding said at least some macroblocks within said random noise portion for use within said normal video portion of said frame.

24. A system for encoding a frame comprising a plurality of macroblocks, said system comprising:

means for using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion, and if so, then for each macroblock of said frame:

(i) means for determining a macroblock activity level;

(ii) means for determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said random noise portion of said frame; and

(iii) means for adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said random noise portion of said frame towards predictive coding and thereby save bits otherwise used to encode said random noise portion of said frame and provide a more constant picture quality due to encoding of the frame.

25. The system of claim 24, wherein said system further comprises means for using said saved bits from said random noise portion of said frame to encode macroblocks associated with said normal portion of said frame.

26. The system of claim 24, wherein each macroblock of said plurality of macroblocks comprises multiple blocks, and wherein said means for determining (i) comprises means for determining an activity level for each block of said multiple blocks of said macroblock, and means for ordering activity levels of said multiple blocks of said

macroblock and comparing a minimum activity level of said order with a next to minimum activity level of said order to derive an activity level for said macroblock.

27. A system for encoding a frame comprising a plurality of macroblocks, said system comprising:

means for determining whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) means for determining a macroblock activity level;

(ii) means for determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) means for adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein each macroblock of said plurality of macroblocks comprising multiple blocks, and wherein said means for determining (i) comprises means for determining an activity level for each block of said multiple blocks of said macroblock, and means for ordering activity levels of said multiple blocks of said macroblock and comparing a minimum activity level of said order with a next to minimum activity level of said order to derive an activity level for said macroblock; and

wherein said means for comparing comprises means for determining whether said minimum activity level is less than one-half said next to minimum activity level and whether said minimum activity level is less than one-half an average activity level of said multiple blocks, and when both are true, for defining said activity level of said macroblock as said next to minimum activity level in said macroblock, otherwise for defining said activity level of said macroblock as said minimum activity level of said order.

28. The system of claim 24, wherein said means for adjusting encoding (iii) comprises means for performing motion estimation on said macroblock and for selectively adjusting macroblock coding type for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined threshold, said selectively adjusting being with reference to a predictive error value resulting from said performing of motion estimation on said macroblock.

29. A system for encoding a frame comprising a plurality of macroblocks, said system comprising:

means for determining whether said frame includes a noisy portion, and if so, then for each macroblock of said frame:

(i) means for determining a macroblock activity level;

(ii) means for determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said noisy portion of said frame; and

(iii) means for adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock and thereby save bits otherwise used to encode said noisy portion of said frame;

wherein said means for adjusting encoding (iii) comprises means for performing motion estimation on said macroblock and for selectively adjusting macroblock coding type for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined threshold, said selectively adjusting being with reference to a predictive error value resulting from said performing of motion estimation on said macroblock; and

wherein said means for selectively adjusting comprises means for determining when said predictive error is greater than a second predefined threshold and when said predictive error is greater than one-half said macroblock activity level, and when both are so, said means for selectively adjusting comprises means for adjusting a macroblock coding type parameter to bias said macroblock towards being coded predictive.

30. The system of claim 29, wherein said means for adjusting encoding (iii) further comprises means for determining an adjusted quantization level for use in encoding said macroblock, said adjusted quantization level being determined to conserve bits used in encoding said macroblock when said macroblock activity level exceeds said predefined threshold.

31. A system for encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said system comprising:

a pre-encode processing unit for using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion; and

a control and encode unit for evaluating each macroblock of said plurality of macroblocks in said frame when said frame includes said random noise portion, said control and encode unit including means for adjusting encoding of at least some macroblocks within said random noise portion of said frame to reduce bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.

32. The system of claim 31, wherein each frame of the sequence of frames comprises a plurality of pixels, each pixel of each frame comprising a multi-bit value, and wherein said pre-encode processing unit comprises means for deriving a frame complexity value and for comparing said frame complexity value to a predefined complexity threshold, said means for deriving of said frame complexity value including means for deriving an accumulated absolute difference (PIX-DIFF) from adjacent pixels of said plurality of pixels of said frame.

33. The system of claim 32, wherein when said frame complexity value is less than said predefined complexity threshold, said pre-encode processing unit further comprises means for setting a noisy picture flag to "0" and performing normal encoding on said frame, wherein said flag set to "0" designates said frame as a non-noisy or normal frame, and when said frame complexity value is greater than said predefined complexity threshold, said pre-encode processing unit comprises means for determining whether a

target bitrate of said frame is less than a predefined bitrate threshold, and when said target bitrate of said frame exceeds said predefined bitrate threshold, said pre-encode processing unit comprises means for setting said noisy picture flag to "0", and when said target bitrate of said frame is less than said predefined bitrate threshold, said pre-encode processing unit comprises means for setting said noisy picture flag to "1", wherein said "1" noisy picture flag setting indicates that said frame includes said random noise portion.

34. The system of claim 33, wherein said control and encode unit further comprises means for determining for each macroblock a macroblock activity level and for determining when said macroblock activity level exceeds a predefined activity threshold, wherein said macroblock activity level exceeding said predefined activity threshold indicates that said macroblock is within said random noise portion of said frame.

35. The system of claim 34, wherein said means for adjusting encoding comprises means for performing motion estimation on said macroblock and means for selectively adjusting macroblock coding type for said macroblock to bias said macroblock towards being coded predictive when said macroblock activity level exceeds said predefined activity threshold, said means for selectively adjusting being with reference to a predictive error value resulting from performing motion estimation on said macroblock, and wherein said control and encode unit further comprises means for determining an adjusted quantization level for said macroblock for use in encoding said macroblock, said adjusted quantization level being determined to reduce bits used in encoding said macroblock.

36. The system of claim 35, wherein said means for adjusting encoding comprises means for conserving bits used in encoding said at least some macroblocks within said random noise portion for use in encoding macroblocks within said normal video portion of said frame.

37. A computer program product comprising a computer usable medium having computer readable program code means therein for use in encoding a frame comprising a plurality of macroblocks, said computer readable program code means in said computer program product comprising:

computer readable program code means for causing a computer to affect using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion, and if so, then for each macroblock of said frame said computer program comprises:

computer readable program code means for causing a computer to affect determining a macroblock activity level;

computer readable program code means for causing a computer to affect determining when said macroblock activity level exceeds a predefined threshold, wherein said macroblock activity level exceeding said predefined threshold indicates that said macroblock is associated with said random noise portion of said frame; and

computer readable program code means for causing a computer to affect adjusting encoding of said macroblock when said macroblock activity level exceeds said predefined threshold to conserve bits used in encoding said macroblock by biasing coding of said macroblock associated with said random noise portion of said frame towards predictive coding and thereby save bits otherwise used to encode said random noise

portion of said frame and provide a more constant picture quality due to encoding of the frame.

38. A computer program product comprising computer usable medium having computer readable program code means therein for use in encoding a frame of a sequence of frames, each frame having a plurality of macroblocks, said computer readable program code means in said computer program product comprising:

computer readable program code means for causing a computer to affect using intraframe statistics to determine without reference to another frame whether said frame includes a random noise portion and a normal video portion; and

computer readable program code means for causing a computer to affect evaluating each macroblock of said plurality of macroblocks in said frame and when said frame includes said random noise portion, adjusting encoding of at least some macroblocks within said random noise portion of said frame, said adjusting comprising reducing bits used in encoding said at least some macroblocks within said random noise portion by biasing coding thereof towards predictive coding.